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NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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Using Black Light to Find Jack-Pine Budworm Egg Masses

ABSTRACT. — Jack pine foliage infested with jack-pine budworm egg masses was examined under two kinds of light — black light and a combination of natural and fluorescent light. Black light significantly increased the accuracy of count but not the efficiency of examination.

Examining branches for egg masses of the jack-pine budworm (*Choristoneura pinus pinus* Freeman) is a tedious, time consuming job. Most egg masses are deposited on the concave surfaces of needles, and are often hidden from view, especially when the needles are compact and appressed. Even experienced examiners may miss some. With the spruce budworm the proportion missed is related to population level, the nature of the foliage, and the experience of the workers.[1]

Our preliminary investigations showed that egg masses fluoresce under black light when the needles are sprayed with a 0.05-percent solution of Fluorescein in 95-percent ethanol. Subsequently, we found that egg masses fluoresce naturally under black light without treatment.

This Note evaluates the aid black light gives examiners searching for egg masses.

Methods and Materials

Eighty branch samples, 2 branches from each of 40 trees, were collected after larval eclosion in August 1967 from the upper crowns of heavily infested jack pine. Branches were placed in cloth bags, transported to the laboratory, and stored in a freezer. Later they were examined under black light and under a combination of fluorescent and natural light.

A standard black-light lamp (F40BLB) with a built-in filter was used for the black-light examinations. The filter absorbs most of the visible light and transmits a high percentage of near-ultraviolet energy. In a windowless room, the lamp was suspended about one foot above a table and shielded so that the examiner's eyes were not in direct line with the emitted light. A 6-volt battery spotlight was provided for checking doubtful egg masses[2] *after* they had been found under black light. Examiners were never permitted to use the spotlight for locating egg masses. Black construction paper covering the working area of the table prevented light reflection.

The other (normal) examinations were conducted in a well-lighted laboratory with a large window, fluorescent ceiling lights, and two standard fluorescent lamps (F15T8·CW) mounted in desk-type receptacles. White paper covering the working area of the table provided contrast.

[1] *See two articles by R. F. Morris: One source of error in budworm population work. Can. Dep. Agr. Div. Forest Biol. Bi-Mon. Progr. Rep. 7(6): 1-2; 1951.* Also *The development of sampling techniques for forest insect defoliators, with particular reference to the spruce budworm. Can. J. Zool. 33(4): 225-294; 1955.*

[2] *Pitch droplets also fluoresce under black light, and occasionally they will resemble an egg mass. A completely parasitized egg mass also may have to be examined under a spotlight.*

The student examiners, three women and one man, had a range of experience examining foliage for egg masses: Examiner 1 had the most experience, examiner 2 (male) had limited experience, while examiners 3 and 4 had none.

Each worker examined 20 branches. Branches were clipped into small workable segments of about 6 inches or less. Branch surfaces without needles were discarded. The small segments were examined by rotating and bending the twigs so that all needle surfaces would be exposed to view. Egg masses found were left in place so that they could be examined under the other light source. Loose needles were also examined. The time required to examine each branch and the number of egg masses found were recorded. The foliage examined one day was reexamined by the same worker 1 or 2 days later under a different light source. The extra time was provided between examinations to reduce any remembrance factors. Examiners 1 and 2 examined foliage first under fluorescent light and then under black light; this order was reversed for examiners 3 and 4.

Efficiency

The total examination time for all examiners was longer under black light (table 1). Examiner 4 took significantly more time under black light than fluorescent light; the reason is not known. Although this examiner's branches were on the average slightly larger than those of other examiners, egg-mass densities found under black light were not significantly different among examiners.

A comparison was made of the percentage of branches where less, the same, or more time was spent under black light than fluorescent light. From 55 to 70 percent of the branches examined by the first three workers required less or the same time using black light, while 80 percent of the branches examined by the fourth worker took more time using black light. When total branches (80) of all examiners are considered, 52 percent were examined in less or the same time using black light.

Table 1. — A comparison of examination time and numbers of jack-pine budworm egg masses found under black light (BL) and under fluorescent light (FL) by each examiner

Examiner	Mean foliated branch length[1]	Examination time			Egg masses found		
		FL	BL	FL-BL	FL	BL	BL-FL
	Inches	Min.	Min.	Min.	No.	No.	No.
1	24.7	259	220	+39	109	114	+5
2	24.1	214	191	+23	83	95	[2]+12
3	23.4	163	151	+12	80	73	-7
4	30.5	137	230	[2]-93	64	100	[2]+36
Total		773	792	-19	336	382	[2]+46

[1] Measured from the first green needles near the base of the branch to the apical bud.

[2] Differences between BL and FL significant at $t_{.05}$ level.

Accuracy

The number of egg masses found under black light significantly exceeded the number found under fluorescent light for two of the four workers (table 1). Examiner 4 found 36 more egg masses and took 93 minutes longer using black light.

On 80 to 90 percent of the branches, examiners 1, 2, and 4 found more egg masses or the same number under black light as they had found under fluorescent light; examiner 3 found the same or more masses on only 60 percent of her branches (table 2). All examiners combined found more or the same number of egg masses under black light on 80 percent of all branches as they found under fluorescent light.

Table 2. — A comparison of numbers of egg masses found under black light (BL) and under fluorescent light (FL) by each examiner

Examiner	Percentage of 20 branches where number of egg masses found was--		
	Greater under BL than FL	Same under BL as FL	Less under BL than FL
1	30	60	10
2	50	30	20
3	25	35	40
4	60	30	10
Average	41	39	20

To determine the characteristics of egg masses missed under black light, examiner 1 reexamined 30 branches under black light and removed all egg masses found. Then under fluorescent light she removed each needle and carefully searched it for any egg masses missed under black light. All egg masses were examined with a stereomicroscope and classified as normal or parasitized. Each class was further subdivided into new and old masses. Of 196 egg masses, 21 were missed under black light. Of these 21 masses, 3 were normal-new, 6 were normal-old, 11 were parasitized-new, and 1 was parasitized-old. Thus nearly all of the masses overlooked under black light were either parasitized or old.

Additional Equipment Needed for Blacklight Technique

The black-light technique requires little additional equipment. Most laboratory rooms can be darkened by mounting photographer's black cloth or sheets of plywood painted dull black over windows. Light entering around door jambs and window casings is not critical so long as the rays do not strike the examiner's working area. Although a 48-inch F40BLB black-light lamp was used in this study, two 18-inch F15T8BLB black-light lamps can be mounted in standard desk-type receptacles for concentrating emitted rays within a limited area. Penlights may be substituted for 6-volt battery spotlights.

Possible Use With Other Insects

Tests showed that spruce budworm egg masses also fluoresce under black light so the technique may be useful for locating eggs of other species of insects.

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